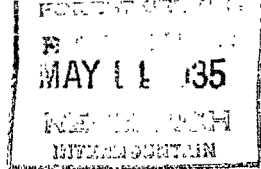


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The Influence of Degree of Cutting on the Survival
and Early Growth of Chestnut Oak Seedlings

by

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Knowledge of silvicultural methods necessary to secure adequate hardwood reproduction of desirable seedling growth is very meager. In the Central Hardwood Region the regeneration of stands deteriorated by fire, grazing, or exhaustive cutting is an important problem. A good restocking of thrifty young seedlings adapted to these sites is highly desirable, especially in stands now consisting largely of decadent or inferior sprouts.

To gain a better understanding of the requirements of native seedlings during early life, a series of studies has been undertaken by the Central States Forest Experiment Station. This progress report deals with growth characteristics of chestnut oak (*Quercus montana*, Willd) seedlings, and provides an insight to the requirements and behavior of this species during early development.

Germination Study. An exceedingly heavy crop of chestnut oak acorns occurred over the entire range of this species in the Central States during the autumn of 1928. In studying germination and early survival of the resulting seedlings in Ohio and Indiana, Barrett (2) found that litter depth, aspect, and, to a certain extent, overhead shade were the most important factors affecting establishment.

The influence of overhead cover in promoting a small but significant additional germination of chestnut oak seedlings is attributed to the beneficial effect of reduced site exposure. As pointed out by Korstian (3) and substantiated by observations of members of the Central States Station (1), this beneficial effect includes the preservation of the forest soil in a condition of optimum density and porosity most favorable to moisture retention and root penetration.

Establishment of Plots. To determine the best methods of developing seedling chestnut oak stands where reproduction was already present, sample plots were established during 1929 on the Clark County State Forest in the "Knobs" region of southern Indiana. Chestnut oak is confined to the non-calcareous hills and ridges of this forest, and occurs in almost pure stands, or mixed with white oak, black oak, post oak, hickories, red maple, Virginia pine, ironwood, dogwood, and chestnut. Sprout "twin trees" are common in these second growth stands.

Three sample plots, each including fifty 10 x 10 link (0.001 acre) quadrats, were established and periodically remeasured for the purpose of this study. Most of the trees were in the 70-80 year age class, with 65 per cent of the basal area in dominant and codominant trees ranging in size

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from 6 to 16 inches D.B.H., and with a stocking of from 600 to 800 trees per acre. The check plot (Plot I), comprising 0.2 acre, was left untreated. Plot II, 0.25 acre in size, was partially cut, leaving about 60 trees, or approximately 50 per cent of the original basal area. Plot III, also 0.25 acre in size, was clear cut. An isolation area given treatment identical with that of the plot was made on a 50 foot strip around each plot.

Seedling Survival. Portions of the remeasurement data are presented in the accompanying tables. Table I shows the effect of cutting the overstory on the survival of seedlings resulting from the 1928 acorn crop of chestnut oak.

Table I

Plot	Treatment	Total Number of Seedlings at end of Growing Season Per Acre				
		1929	1930	1931	1932	1934
I	No cutting	48,500	28,380	16,660	12,400	5,200
II	Partial cutting	36,080	24,400	14,540	14,280	12,460
III	Clear cutting	38,260	28,180	11,320	10,380	10,380

The most common factors influencing seedling mortality on these plots included drought, rodent injury, root decay, and galls. Severe drought, particularly that of 1930, caused heavy mortality. Mice and rabbits were very destructive to seedlings during the first year or two. Oak galls resulted in dead stems and formation of seedling sprouts. Within the uncut check plot there was apparent a constant decrease in the number of seedlings and a steady diminishing of the vigor of the survivors. The superior survival of seedlings on the partially cut plot is evident, but their small size and lack of development reduces their significance. The number of seedlings remaining after five years on the clear cut plot is still sufficient to insure good stocking, and the fact that mortality was low and growth good in the past three growing seasons is significant.

Seedling Growth. Table II, showing the effect of cutting the overstory on the growth of chestnut oak seedlings, clearly indicates that partial cutting resulted in little or no improvement in seedling growth of chestnut oak over the uncut area, whereas the clear cutting resulted in seedlings 4.7 times as large as those on the uncut plot during the period 1929 to 1934.

Table II

Plot	Treatment	Average Height of Seedlings at end of Growing Season In Inches				
		1929	1930	1931	1932	1934
I	No cutting	3.7	4.7	5.1	5.3	6.5
II	Partial cutting	3.9	4.7	5.4	5.3	8.1
III	Clear cutting	3.3	5.6	11.2	22.8	30.8

It is even more significant to note that in the uncut plot few seedlings exceeded 8.0 inches in total height by 1934, in the partially cut plot the largest were 14.0 inches tall, whereas in the clear cut plot many seedlings had grown to a height of 53.0 inches.

Sprout Growth. Abundant and rapidly growing sprouts of chestnut oak increase the difficulties of securing seedling regeneration after cutting. Within the clear cut plot there were 276 clumps totaling 2460 sprouts per acre with an average height of 124 inches, or about 4 times as large as the seedlings. Some of the most vigorous sprouts were 16 feet tall in 1934. A comparison of subsequent sprout and seedling growth is being made in this plot, to determine whether or not the seedling growth can compete successfully with the fast starting sprouts. On one portion of the plot the sprouts have been cut back to favor the seedlings.

The difficulties of securing satisfactory advanced reproduction through selection cutting in the chestnut oak type are emphasized both by the failure of seedlings to grow well, as evident in Plot II, and by the behavior of sprout growth in comparison with that on the clear cut area. 268 clumps with 1140 sprouts per acre were found, having an average height of 58 inches. Rapid growth of these was not being maintained by 1934. Many of the openings in the partially cut plot were being occupied by seedlings and sprouts of sassafras, red maple, flowering dogwood, and scarlet oak. These species were much more abundant here than in the clear cut plot. This suggests the difficulties in attempting to maintain good all-aged stands through selection cutting in the oak type on relatively dry sites. Such practice usually favors reproduction of the more tolerant species of minor importance.

Summary. It becomes apparent, from this study, that an overhead stand of chestnut oak is necessary for an abundant crop of seedlings to become established, but they grow very slowly and do not develop beyond the seedling stage. Partial cutting does not permit satisfactory seedling growth and likewise hinders sprout development of oak, but leads to the formation of a slow-growing understory of tolerant minor species. Clear cutting, after oak reproduction is established, encourages rapid growth both of seedlings and sprouts, but the fast growth of the latter may threaten the ultimate development of the seedlings. Obviously more studies are needed to determine the best methods of reproducing oak stands.

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